

Simulation of Front to Back Ratio and Front to Rear Ratio in Elevation Pattern Analysis of a Typical LPDA

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ABSTRACT: In this paper the variations of Fr/Back (dB) and Fr/Rear (dB) of a Log Periodic Dipole Antenna (LPDA) as a function of frequency are depicted. We have considered the different Azimuth Angles for the variations of Fr/Back (dB) and Fr/Rear (dB) in Elevation Pattern Analysis. We have tried to design a LPDA that is suited to the criteria, specification and is useful for practical purposes.

KEYWORDS: LPDA, Front-to-back-ratio, Front-to-rear –ratio, Azimuth angle

I. INTRODUCTION

The front-to-back ratio (F/B) is utilized to explain the level of radiation from the rear of a directional antenna [1, 4] The ratio contrasts the antenna gain in a particular direction, i.e., azimuth, typically that of maximum gain, to the gain in a way of 180° from the specific azimuth. In case of point-to-point microwave antennas, a good functioning antenna generally possesses a higher front to back ratio than other antennas. **In other cases** the front to back ratio is a ratio of parameters utilized to illustrate rectifiers or other appliances, in which electrical current, signal strength, resistance, or other parameters, in a single direction is compared with that in another direction.

II. LOG PERIODIC DIPOLE ARRAY

LPDA antenna is a kind of broadband, multi-element, unidirectional antenna with superior directivity. This antenna is appealing for various communication applications like commercial broadcast and detection of radio signals. An LPDA can be expressed by two geometric parameters, a scale factor τ that indicates the comparative lengths and a spacing factor σ that signifies the relative spacings of the antenna elements [5-11]. Ratio of each element to each adjoining element is fixed, and is put a value which is known as tau (τ). The other significant factor in the design of the LPDA is the relative spacing among the elements specified by the factor sigma (σ). The LPDA can be functioned over a wide range of frequencies possessing a ratio of 2 :1 or more, and over this specified range its electrical features such as gain, feed-point impedance, front-to-back ratio, etc. is almost steady. Figure 1 shows Log Periodic dipole array showing the direction of maximum.

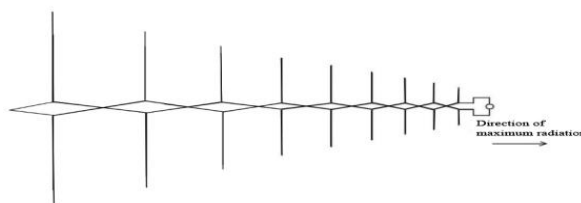


Fig. 1 Log Periodic Dipole Array showing the direction of maximum radiation

With variations in operating frequency, there is a smooth movement all along the array of the elements which includes the active region. The active region, i.e., the portion of the antenna which is really emitting or receiving radiation effectively, moves with frequency[12-14] The longest dipole element in the LPDA is active at the lowest frequency where it performs as a half wave dipole. As the frequency moves upward, the active region shifts in the frontward direction.

III.SIMULATION RESULTS

The variation of simulated Front/Back ratio (dB) as a function of frequency in different azimuth angles are shown in Figures2(a),2(b),2(c),2(d),2(e).

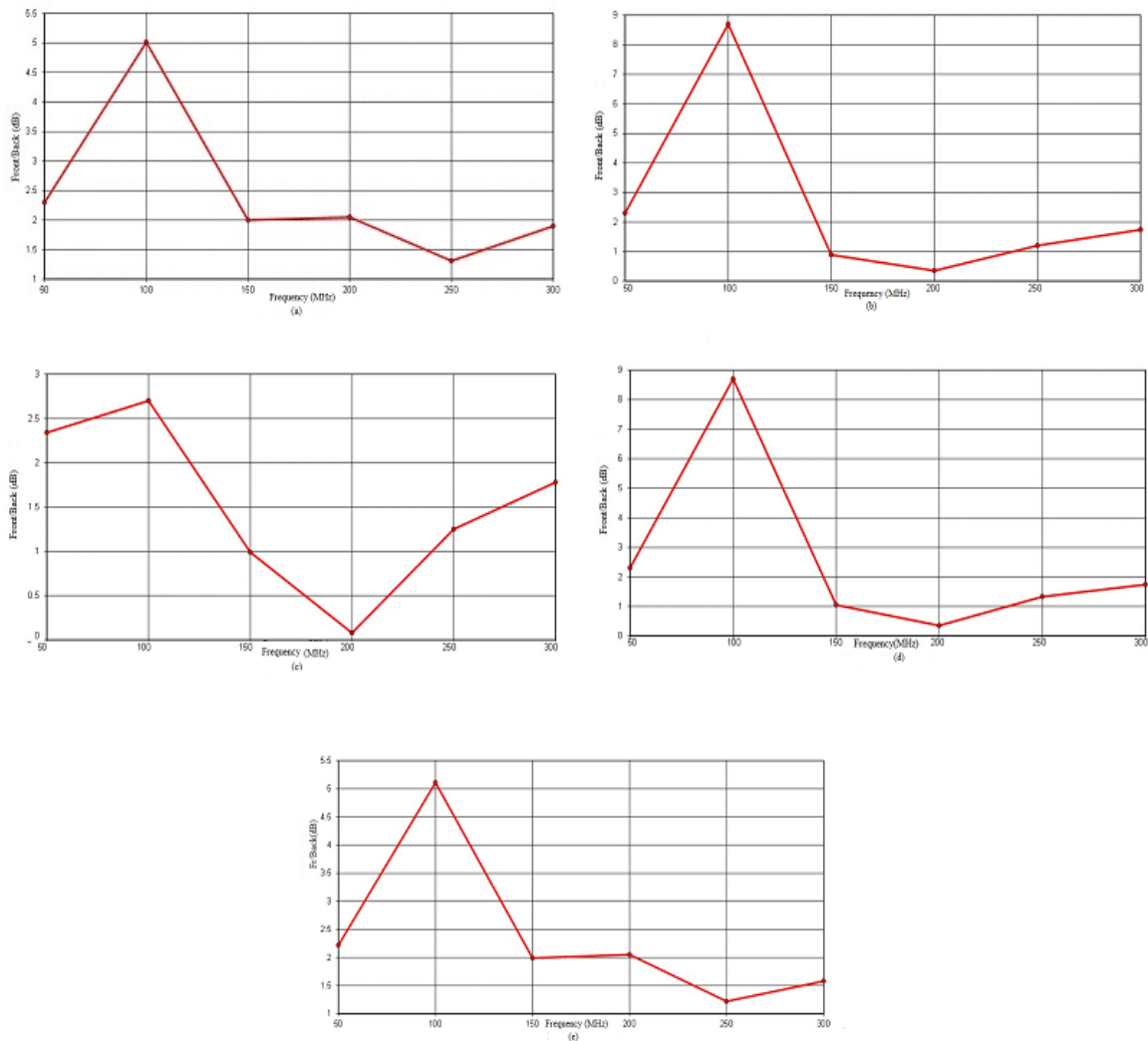


Fig. 2 The variation of Fr/Back (dB) VS Frequency (MHz) (a) 163° Azimuth Angle (b) 167° Azimuth Angle (c) 172° Azimuth Angle(d) 193° Azimuth Angle(e)) 204° Azimuth Angle in Elevation Pattern Analysis

Similarly the variation of simulated Front/Rear ratio (dB) as a function of frequency in different azimuth angles are shown in Figures3(a),3(b),3(c),3(d),3(e) respectively.

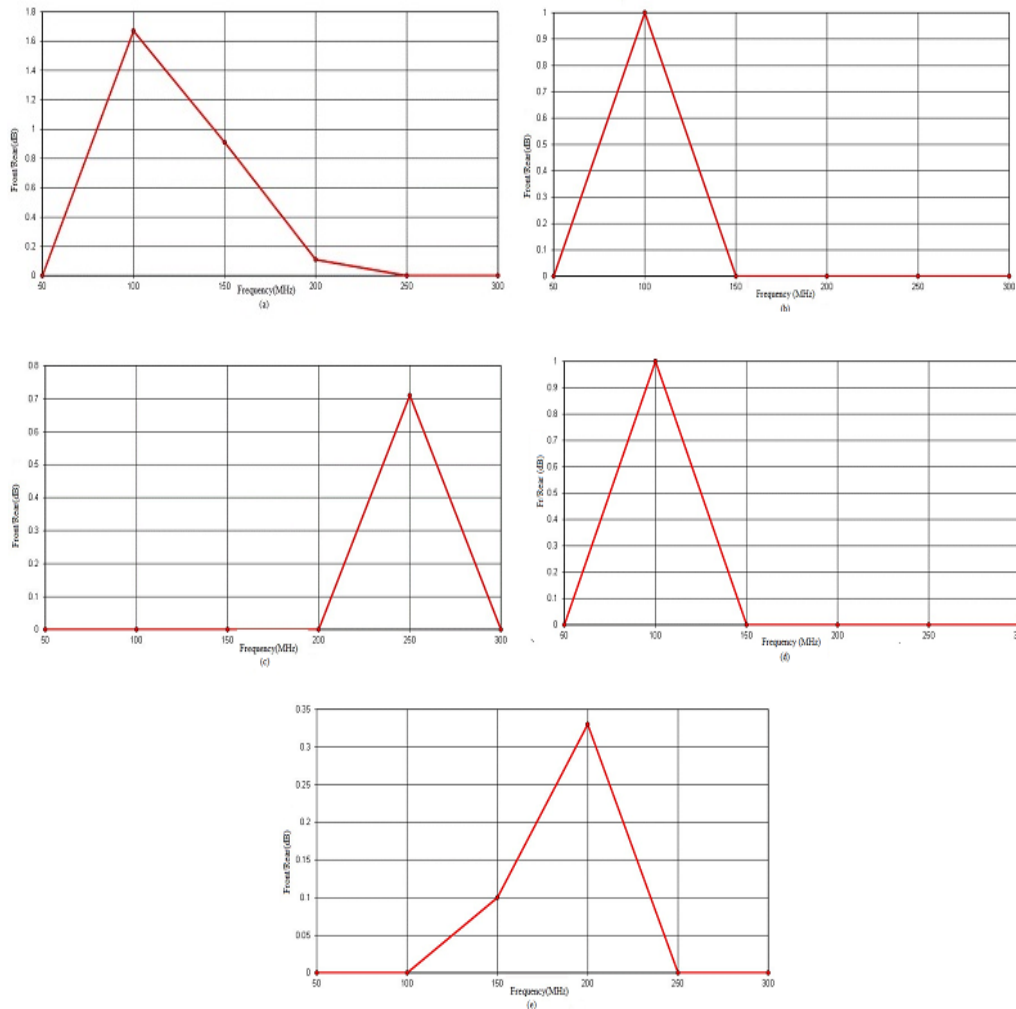


Fig. 3 The variation of Fr/Rear (dB) VS Frequency (MHz) (a) 163° Azimuth Angle (b) 167° Azimuth Angle (c) 172° Azimuth Angle(d) 193° Azimuth Angle(e)) 204° Azimuth Angle in Elevation Pattern Analysis

The antenna was simulated using EZNEC software and it was considered under free space. We have noticed in the figures 2(a), 2(b),2(c),2(d) and 2(e) that the Fr/Back ratio is increased from 50 MHz to 100 MHz and at 100 MHz Fr/Back ratio is the maximum. It is also observed that in the above figures, from 100 MHz Fr/Back ratio is gradually decreasing. In figure 3(a), we have observed at 163° Azimuth angle that the Fr/Rear ratio is increased from 50 MHz to 100 MHz and then from 100 MHz it is gradually decreasing to 200 MHz. In figure 3(b) we have noticed that at 167° Azimuth angle, the Fr/Rear ratio is increased from 50 MHz to 100 MHz and then after 100 MHz Fr/Rear ratio is gradually decreasing to 150 MHz.

Again it is seen in the same Figure 3 (b) that Fr/Back ratio is maximum at 100 MHz and after 150 MHz Fr/Rear ratio is shown as a straight line. We have also noticed important observations at 172° Azimuth angle that Fr/Rear ratio does not vary up to 200 MHz and after 200 MHz Fr/Rear ratio is gradually increasing to 250 MHz which is again decreasing gradually to 300 MHz as shown in figure 3(c). In figure 3(d), we have got the same results at 193° Azimuth Angle as in figure 3(b). In figure 3(e), we have got interesting results at 204° Azimuth Angle that the Fr/Rear ratio does not vary up

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to 100 MHz but after 100 MHz, Fr/Rear ratio is gradually increasing up to 200 MHz and at 250 MHz Fr/Rear ratio is maximum.

IV.DISCUSSION

The built LPDA possess features like high gain, large bandwidth, high front to back ratio (F/B) and low cost. Its benefit is that it shows continuous characteristics such as similar radiation resistance (and so the same SWR), and identical pattern characteristics (more or less the same gain and the same front-to-back ratio) throughout the frequency range. An antenna having high front-to-back ratio is helpful for restraining interference that appears at the back of the antenna. Nevertheless, the interference frequently comes from other directions. A more valuable suggestion of antenna response from directions other than directly in front of the antenna is the front-to-side lobe ratio. Front-to-side lobe ratio is the ratio of the peak major lobe gain and the gain of the lobe with the second largest gain. Side lobes are simply noticed by examining the patterns. The F/R ratio is between 20 and 30 dB and so always higher than 20dB in the whole frequency range, as necessary in the optimization process.

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